

Starter Questions

1 Prove that the product of two odd numbers must be odd.

4 Simplify

a $(-s^4)^3$

b $\sqrt{64c^{64}}$

c 3^{-4}

d $(k^2)^{-3}$

5 a Express $\sqrt{275}$ in its simplest form.

b Rationalise the denominator of $\frac{3 - \sqrt{a}}{\sqrt{a} + 1}$

L3

Interpret measures of central tendency and variation, extending to standard deviation.

Be able to calculate standard deviation, including from summary statistics.

Students should be able to:

- find the mean, median, mode, range, quartiles and interquartile range from data given in graphical or tabular form
- interpret values of the mean, median and mode and recognise these as measures of central tendency
- calculate standard deviation (or variance) using a calculator or from summary statistics of the form $\sum x$, $\sum x^2$ or $\sum (x - \bar{x})^2$
- recognise the standard deviation, variance, range and interquartile range as measures of variation.

Notes

- Students are expected to use a calculator's statistical functions to find **all** statistics for a set of data presented as a list or in a frequency table, including estimating for grouped data.
- Linear interpolation of median and quartiles for grouped data is not required.
- Whilst an informal understanding that there are two different values for standard deviation given on a calculator is useful, this specification does not formally address the estimation of population parameters by sample statistics. Thus, the formula we will use for standard deviation is $\sqrt{\frac{\sum x^2}{n} - \bar{x}^2}$ (which is given in the formulae book), but students will not be penalised for using the unbiased estimator of the population standard deviation.
- Use of any particular symbol (s or σ) for standard deviation in statistics will be avoided in exam questions, because of the potential for confusion. Students will need to recognise the correct value of standard deviation on a calculator.
- For small data sets, the positions of the median and quartiles are usually given by $\frac{n+1}{4}$, $\frac{n+1}{2}$, $\frac{3(n+1)}{4}$ and it will often be convenient to ensure $n+1$ is a multiple of 4
- However, the quartiles are more relevant to large sets of data and here it is usually more convenient to replace $n+1$ by n
- Whenever possible, students should use a calculator to determine quartiles.
- Understand that values of statistics are estimates of the corresponding population parameters.

9.2 Central Tendency & Spread

Definitions

Discrete data □ can be one of a finite set of categories (non-numeric) or values (numeric), nothing in between. Data that can be counted, e.g. shoe size; pencils in a box.

Continuous data □ can only be numeric and can take any value between two points on a number line. Data that can be measured, e.g. weight; height.

Raw data □ quantities obtained by

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Definitions

Summary Statistics □ key values which can represent the set of raw data, e.g. averages and spread.

Measure of central tendency □ also knowns as measures of location or averages, e.g. mode; median; mean.

Measure of dispersion □ also known as spread, e.g. range; interquartile range; variance; standard deviation.

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Measures of Central Tendency

Mode □ the value or category that occurs the most often or has the largest frequency. For grouped data only the **modal group** or **modal interval** can be stated.

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Measures of Central Tendency

Median □ arrange the data in ascending order, the value in the middle of the list is the median.

If the number of pieces of data is odd then the median will be one of the data values. If the number of pieces of data is even then the median is the mid-point of the two middle values.

The middle position of n observations is found by using $\frac{n+1}{2}$. Can use $\frac{n}{2}$ for large sets of data.

For grouped data, only the median group or median interval can be stated.

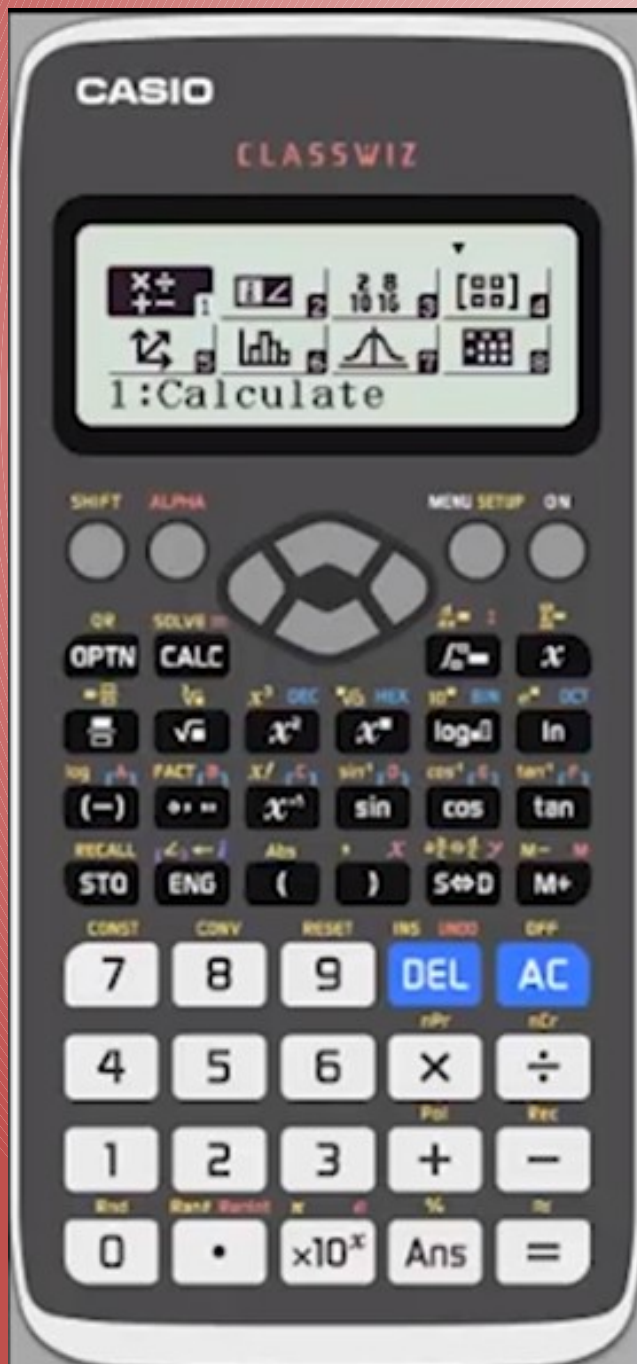
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Measures of Central Tendency

Mean () □ calculate the sum of the set of n observations, then divide this sum by $\bar{x} = \frac{\sum x}{n}$

For a set of data given in the form of a frequency distribution (table), the mean is $\bar{x} = \frac{\sum fx}{\sum f}$ calculated by

For a set of data given in the form of a grouped frequency distribution, an estimate of the mean can be found by taking the midpoint of each group and using $\bar{x} = \frac{\sum fm}{\sum f}$



Switching on the frequency column:

Shift > Setup > Scroll down > 3: Statistics > Frequency? 1: On
 (It will stay on once you do this)

Enter ...
 Me ...
 Va ...
 Ta ...

X	Freq
Enter data... Use mid-points if grouped	Enter frequencies ...

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Example 1

Find the mode, median and the mean for:

4, 3, 11, 4, 10, 9, 3, 8, 7, 8, 12, 3 ($n = 12$)

Mode = 3

Median: 3, 3, 3, 4, 4, 7, 8, 8, 9, 10, 11, 12

Position of the median = $\frac{n+1}{2} = 6.5^{\text{th}}$ value

median = 7.5

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Example 1

Find the mode, median and the mean for:

4, 3, 11, 4, 10, 9, 3, 8, 7, 8, 12, 3 ($n = 12$)

Mean =

mean = 6.83 (3sf)

From the calculator

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Example 2 - from a frequency table

A scientist counts the number of eggs in some song thrush nests. His data is shown in this table.

Number of eggs, x	2	3	4	5	6
Number of nests, f	4	9	16	8	3

Find the mean, median and mode.

Mean:

Mode = 4 eggs

Median:

From the calc:

\therefore median = 4 eggs

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Example 3 - from a grouped frequency table

The following table gives the heights, to the nearest metre, of a number of trees. Find the modal group, the median interval and an

Height (m)	No. of trees	Midpoint (x)	fx
0 - 5	26	2.5	65
6 - 10	17	8	136
11 - 15	11	13	143
16 - 20	6	18	108

Modal group: 0 - 5m
Median interval:

median interval = 6 - 10m

Mean:

From the calc:

Median = 8 which refers to the mid-point, the median group is 6-10.

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Example 4

The mean of seven numbers is 9. When an extra number is added, the mean becomes 9.5. Find the value of the extra number.

So the extra number is 13.

9.2 Central Tendency & Spread

Example 5

A scientist is looking at the amount of rainfall over a week.

The mean of the first 5 days is $\bar{x}_1 = 4.1$ mm

and the mean of the next 2 days is $\bar{x}_2 = 19.9$ mm.

Find the combined mean (\bar{x}) of the rainfall over the week.

CGP Exercises

Find an estimate of the mean from this histogram:

Amir is a sales manager who drives 100km to get to work. He times the journeys he makes in a six-month period and represents the data in the histogram below.

